PTO 05-4615

CY=JA DATE=19780628 KIND=B
PN=53-020780
JP 78-020780

STERILIZATION DEVICE FOR WATER-PURIFIER USE
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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. July 2005

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	JP
DOCUMENT NUMBER	(11):	53020780
DOCUMENT KIND	(12):	B
	(13):	PUBLISHED EXAMINED APPLICATION (Kokoku)
PUBLICATION DATE	(44):	19780628
APPLICATION NUMBER	(21):	47105487
APPLICATION DATE	(22):	19721020
INTERNATIONAL CLASSIFICATION	(51):	C02B 1/14, B01D 35/04, C02B 3/10
DOMESTIC CLASSIFICATION	(52):	
PRIORITY COUNTRY	(33):	
PRIORITY NUMBER	(31):	
PRIORITY DATE	(32):	
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TITLE	(54):	STERILIZATION DEVICE FOR WATER-PURIFIER USE
FOREIGN TITLE	[54A]:	Josuiki No Mekkinsoshi

SPECIFICATION

54. Title

STERILIZATION DEVICE FOR WATER-PURIFIER USE

57. Claims

1. A sterilization device for water-purifier use, said device having a powder of a sintered compact that is a mixture of a salt that contains positive ions or negative ions having a sterilizing effect and of glass, a synthetic resin that functions as an adhesive, and a substrate for supporting these and said device being prepared by bonding the aforesaid sintered-compact powder to the aforesaid substrate with the use of the aforesaid synthetic resin.

[Detailed Description of the Invention]

The object of the present invention is to add a sterilization function to commercially available water purifiers. More specifically, it intends to sterilize filtered water that is obtained by eliminating chlorine gas, bleaching powder, and the like contained in cities' tap water with active carbon in water purifiers. In particular, it intends to impart a sterilization function to water purifiers with the use of a silver salt that is hardly soluble in water--for example, silver chloride, silver bromide, or silver iodide.

None of the water purifiers that are currently available on the market has a sterilization function. However, when the intended purpose of tap water is considered, with currently available water purifiers, the infestation of common germs and coliform bacteria could

occur in the filtered-water section of water purifiers as a result of careless handling because filtered water, which results from eliminating chlorine and bleaching powder with active carbon, does not have a sterilizing ability. In view of this danger of bacterial contamination, there is a need for providing a sterilization device for commercially available water purifiers. There are various disinfectants that can be used for water, but, considering the intended purpose of water purifiers, they should not affect the taste of water, and silver salts that are hardly soluble in water are considered suitable. From the standpoint of the solubility of silver salts, the present invention selects silver chloride (solubility in water: 10^{-5} mol/L), silver bromide (solubility in water: 10^{-6} mol/L), and silver iodide (solubility in water: 10^{-8} mol/L). As conceivable ways to add a sterilizing ability to household-use water purifiers with the use of, for example, silver chloride, there are a method of mixing silver chloride powder into active carbon and a method of adsorbing silver chloride to active carbon. These methods, however, have various disadvantages. Namely, in the case of a water purifier in which a filter fabric containing powdered active carbon and a water-collecting pipe are integrated into one piece, there are the following disadvantages.

(1) The active carbon particles other than those that are effectively precoated onto the surface of the filter fabric precipitate to the bottom of the cartridge having the filter fabric

layer, and the silver chloride that is adsorbed to or mixed with the precipitated active carbon is scarcely utilized.

(2) Active carbon has an absolute specific gravity of 2.0 and an apparent specific gravity of approximately 0.20, while the absolute specific gravity of silver chloride is 5. Due to this substantial difference in their specific gravities, silver chloride powder separates from active carbon and precipitates to the bottom of the cartridge having the filter fabric layer, which fact translates into poor utilization of silver chloride. In addition, it is difficult to dissolve out Ag^+ ions constantly in an amount that is necessary to sterilize germs.

(3) Even if active carbon containing silver chloride is uniformly precoated over the surface of the filter fabric layer, because the quantity of Ag^+ ions that are initially dissolved out is large, there is a tendency for the quantity of dissolved Ag^+ ions to rapidly decrease with use. There are two conceivable causes for this. One is that the surface of active carbon is precoated with foreign matter, and this contamination causes the reduction of dissolved Ag^+ ions. The other is that adsorbing silver chloride in a thick layer to the surface of active carbon causes the capability of the active carbon proper to deteriorate, thus rendering it unusable for water purifiers. Even if it is adsorbed thinly, the ions are dissolved out in a large quantity initially, and silver chloride could run out before the life of the active carbon.

(4) It is extremely difficult to check the degree of adsorption of active carbon for the purpose of quality control.

(5) There is a conceivable danger that minute silver chloride particles flow into the filtered water in a colloidal form and are ingested by human beings.

(6) Household-use water purifiers do not need to have a disinfectant inserted into it on the active-carbon side of the filter fabric, that is, the water-source side, for a sterilization purpose because chlorine or bleaching powder is present on that side. Infestation of germs occurs on the water collecting side inside cities [sic] through which the filtered water passes. Infestation of germs occurs on the water collecting side inside the fabric through which the filtered water passes.

Considering the aforesaid characteristics of silver salts and the structure of water purifiers, the present invention provides a sterilization device that sterilizes germs when installed on the filtered-water side (or in the vicinity of the water-collecting pipe in the filter fabric if the filter fabric and the water-collecting pipe are constructed in one piece) of a commercially available water purifier, thus rendering it useful for water purifiers.

The following explains one embodiment of the present invention in concrete terms, referring to figures. In the figures, reference numeral 1 indicates a sealed cylindrical case, which is composed of a case proper (2) and a lid (3). At the bottom of the case proper (1) is

formed an inflow hole (4) that connects to a water line, and a faucet (5) is provided at the center of the lid (3) in a rotatable manner. Reference numeral 6 indicates a cartridge that is housed in the case (1). It is made from a synthetic resin and formed in a cylindrical shape, and it has ports (7, 7) at its under surface. There is a space (8) provided between this cartridge (6) and the case (1). Reference numeral 9 indicates a filtering body that is housed inside the cartridge (6), and it is constructed by wrapping a coarsely meshed porous resin frame (10) that is formed in a long rectangular shape with a filter fabric made of a close-grained cloth comprised of resin fibers and by sealing the opening with a resin adhesive. At the center of this filtering body (9) is inserted the lower portion of a resin-made water-collecting pipe (12), and the portion of the water-collecting pipe (12) that is positioned inside the filtering body (9) has a large number of water-collecting holes (13). This filtering body (9) is housed in a serpentinely bent condition, as shown in Fig. 2, inside the cartridge (6). The top end of the water-collecting pipe (12) runs through the cartridge (6) and connects to the faucet (5). Reference numeral 14 indicates active carbon powder that is placed inside the cartridge (6). Reference numeral 15 indicates a seal for closing the ports (7, 7) so as to prevent the active carbon powder (14) from leaking out from the cartridge (6). It normally has the same property as that of common paper, but, once it is wetted with water, it dissolves in a few seconds. Reference numeral 16 indicates an air

vent hole that is provided at the top part of the case (1); 17, its plug; 18, an air vent hole that is provided at the top of the cartridge (6); and 19, a filter that seals air vent hole 18. This filter has a porosity that allows air and water to pass through it but does not allow the active carbon powder (14) to pass through. Reference numeral 20 indicates a sterilization device that is prepared by bonding, as the disinfectant, a sintered-compact powder that is a mixture of a silver salt and glass to a substrate by means of an adhesive, and it is inserted into some part of the resin-made frame (10). This sterilization device (20) is, as shown in Fig. 6, a film-shaped device that is prepared by bonding a sintered-compact powder (21) that is a mixture of a silver salt and glass to a substrate (23) by means of an adhesive (22). It is configured in such a way as to expose the silver-salt-containing sintered-compact powder (21) that is bonded to the substrate (23) by means of the resin adhesive (22) at the surface.

The following explains the operation of the water purifier thus configured. When water is supplied through the inflow hole (4) from a water line, the water-soluble seals (15, 15) are dissolved, thus opening the ports (7, 7). As a result, the tap water enters the cartridge (6) through the ports (7, 7) and stirs the active carbon powder (14) and subsequently precoats the external surface of the filtering body (9) with the active carbon powder (14) as the water flows into the filtering body (9), thereby forming an active carbon

powder layer on the external surface of the filtering body (9). As a result, the tap water is filtered by the active carbon powder layer (14), thus eliminating bleaching powder, chlorine gas, etc., contained in the water. The water, after being filtered, passes inside the filtering body (9) and is collected at the portion of the water-collecting pipe (12) where there are water-collecting holes (13), after which the water flows through the water-collecting pipe (12) and is supplied to the outside from the faucet (5). Meanwhile, the silver salt that is placed inside the filtering body (9) in an area near the water-collecting pipe (12) and in other areas as necessary dissolve gradually into the water, and the resulting Ag^+ ions perform sterilization inside the water purifier. As a result, the possibility of infestation of germs inside the water purifier can be eliminated. A water purifier in which was embedded this sterilization device was actually installed in water and sewerage systems [sic], and the content of the Ag^+ ions in the initial fraction of the filtered water was measured after the passage of 24 hours and found to be 45 ppb. Into this filtered water in which these Ag^+ ions were present, coli bacteria (Escherichia Coli K-IZ-A) whose concentration was adjusted to 6×10^8 cells/mL were added. It was confirmed that the coli bacteria were killed completely within 6 hours of the addition.

The following explains the sterilization device of the present invention used for water purifiers. It is produced as follows. As the glass, soda quartz glass [as transliterated] is used. The composition

of this glass is 15 % by weight Na_2O, 15 % by weight CaO, and 70 % by weight SiO_2. This glass is pulverized and run through 150 mesh. To this glass is added $AgNO_3$, AgCl, and Ag metal powder discretely and mixed, and each resulting mixture is formed by a press under a pressure of 50 kg/cm^2. Each formed product is baked at 900 °C, 800 °C, or 700 °C and subsequently pulverized, thereby forming a powder. The particle size of this powder is set to 150 mesh or smaller. To this powder is added an epoxy resin to form an enamel, and it is printed on a substrate comprised of Mylar film and baked at 100 °C for 2 hours. The content of AgCl, $AgNO_3$, or Ag metal powder in the glass here is set either to 50 % by weight or 80 % by weight. The resin used for forming the enamel is composed of 42 g Epicoat 815, 18 g Adeca Resin EP 4000, and 40 g Epomate B002. A sterilization device that was prepared in the aforesaid manner was immersed in water that had been run through a water purifier, and the quantity of dissolved Ag^+ ions was measured.

The following table shows the quantity of the dissolved Ag^+ ions that was obtained when the aforesaid sterilization device was cut into pieces having an area of 3 x 3 cm^2 and immersed into 20 cc filtered water. The quantity of dissolved Ag^+ ions was measured by atomic absorption analysis, using an atomic absorption analyzer manufactured by Beckman Co.

Type of Silver Salt and Its Content (wt %)	Dissolving Time (hr)	Quantity of Dissolved Ag^+ Ions (ppb)
$AgNO_3$ (50)	0.5	40
	1	45
	3	45
	5	45
$AgNO_3$ (80)	0.5	40
	1	45
	3	45
	5	45
AgCl (50)	0.5	40
	1	45
	3	45
	5	45
AgCl (80)	0.5	45
	1	45
	3	45
	5	45
Ag Powder (50)	0.5	40
	1	50
	3	45
	5	45
Ag Powder (80)	0.5	45
	1	45
	3	45
	5	50

In the aforesaid embodiment, a hardly-soluble silver salt as the disinfectant were bonded on one side of a substrate by means of an adhesive, but it goes without saying that they can be bonded on both sides of a substrate in the same manner.

As is evident from the explanation in the foregoing, according to the present invention, a silver salt used as the disinfectant is mixed with glass and formed into a sintered-compact powder, and this sintered-compact powder is bonded to a substrate with a resin

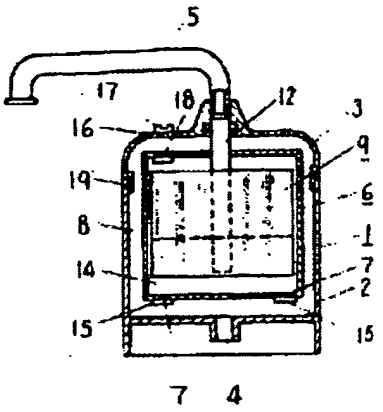
adhesive; therefore, the silver-salt particles are less likely to detach from the substrate or the adhesive, and, even if they did detach, they are harmless to human beings because they are coated with glass. Therefore, with this sterilization device, it is less likely that sintered-compact powder containing silver-salt particles is detached when it is housed on the filtered water side of a water purifier and exposed to water pressure, etc. Furthermore, it can eliminate the problem of peeling completely, compared with devices obtained by vapor deposition, etc. Compared with the method of mixing a silver salt with active carbon, the quantity of dissolved Ag^+ ions is highly stable. By forming the substrate from a flexible film, the device can be installed or removed quite easily. Thus, the device has various excellent advantages.

[Brief Explanation of the Drawings]

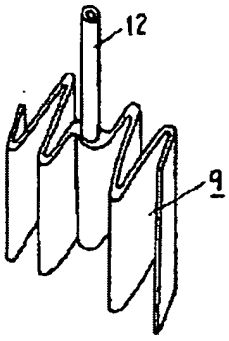
Fig. 1 is a cross-sectional drawing of the water purifier pertaining to the present invention. Fig. 2 is a perspective view of the filtering body of the aforesaid water purifier. Fig. 3 is a center-section drawing of the filtering body. Figs. 4 and 5 are an enlarged plan view and enlarged cross-sectional view, respectively, of the filtering body for illustrating the way the sterilization device is installed. Figs. 6 is an enlarged cross-sectional drawing of the sterilization device used in the aforesaid water purifier.

20 … sterilization device, 21 … sintered-compact powder, 22 … resin adhesive, 23 … substrate.

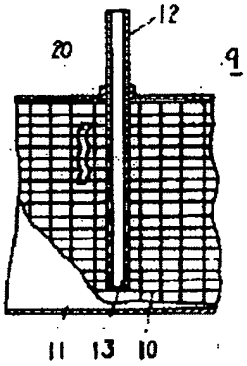
[FIG. 1]



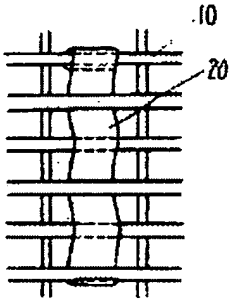
[FIG. 2]



[FIG. 3]



[FIG. 4]



[FIG. 5]

[FIG. 6]